Our Method At a Glance

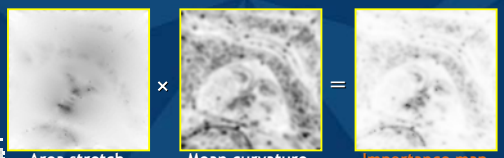
Remeshing Pipeline:

- Geometry Analysis - input-dependent
  - Parameterization (remove embedding)
  - Geometry Maps (2D images to substitute for 3D)
- Remeshing Design - realtime
  - Flexible Design (use conventional DSP tools)
  - Realtime Resampling (use error diffusion)
- Mesh Generation - output-dependent
  - Triangulation and Reprojection (2D back to 3D)
  - Final Optimization (only if needed!)

Remeshing Design

Design of the desired vertex density

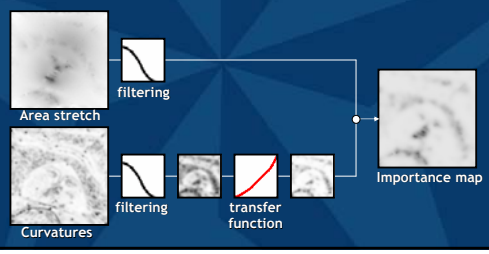
- Select a sampling criteria
  - Can use any combination of precomputed maps
  - Or any user-defined, spray-painted map
- Multiply (pixel by pixel) by the area map
- ⇨ Importance map (sampling space)



Importance Map Design

DSP for improved control over design

- Filters (e.g., to control mesh gradation)
- Transfer functions (e.g., to tune local density)

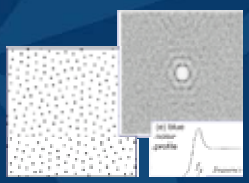


Realtime Resampling

2D Error Diffusion on Importance Map

- Half-toning technique to mimic density
- All samples computed in a single sweep

[Ostromoukhov '01]



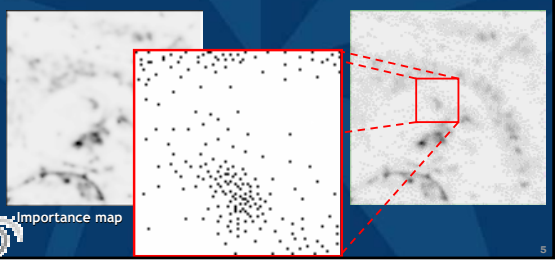
Blue-noise profile,
ensuring near optimal placement

Real-time Resampling

Example:

- 512 × 512 picture in 15ms

  Independent of vertex budget!



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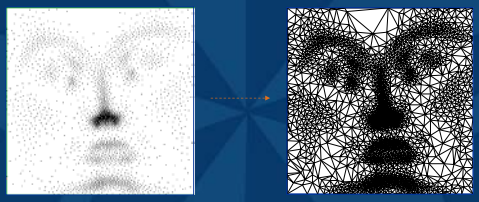
Mesh Generation

- **Triangulate in parameter space**
  Delaunay, for instance [CGAL '02, Shewchuk '97]



- **Connectivity optimization**
  Swap edges to improve mesh regularity, aspect ratio, etc.

Mesh Generation

If higher accuracy is needed...

Optimize positions of vertices

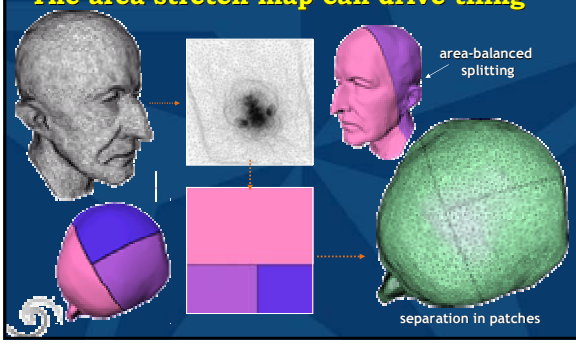
- to improve match with importance map
- using weighted Laplacian, for instance

$$\frac{dx_i}{dt} = \sum_j w_j (x_j - x_i)$$

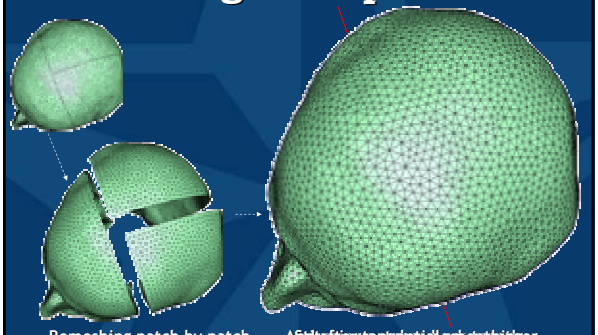
weights are computed using integration over the triangles on 2D maps

Remeshing Example

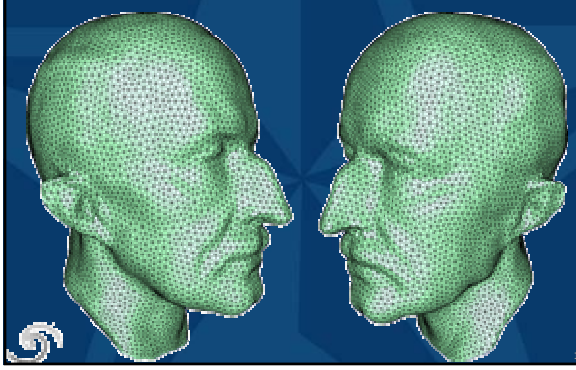
The area stretch map can drive tiling



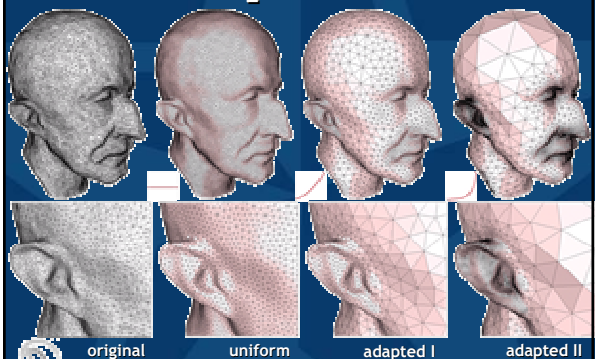
Remeshing Example



Remeshing Example



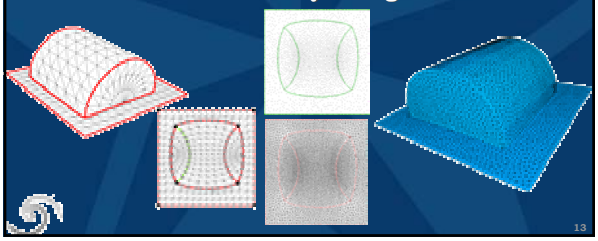
More Examples



Preserving Features

Using a *Feature Skeleton*

- Extract feature graph
- 1D error diffusion along features
- Constrained Delaunay triangulation



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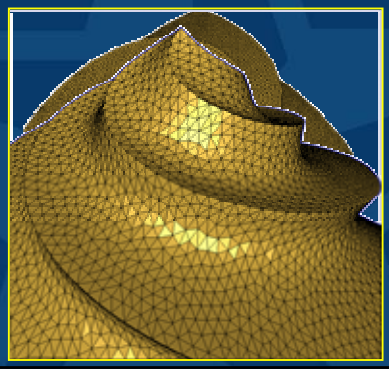
Example With Sharp Edges



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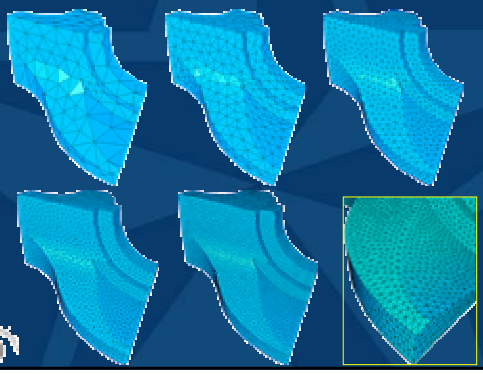
Fandisk Continuum



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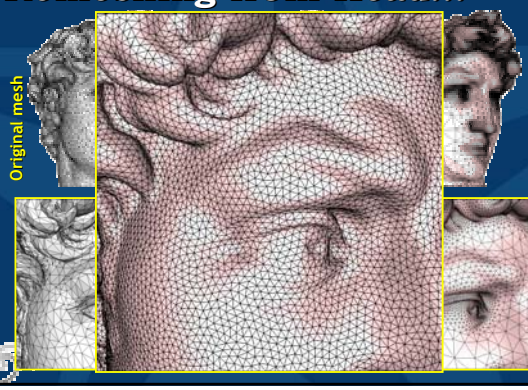
Remeshing from Head...



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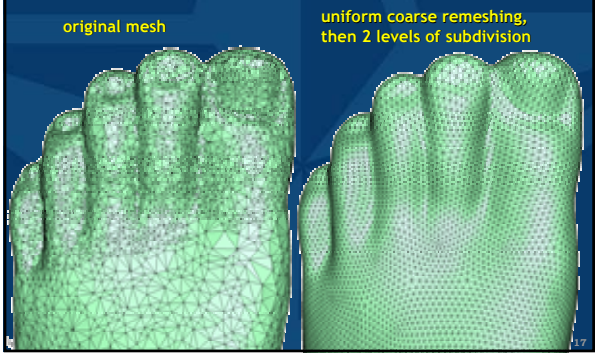
... to Toe



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Other things you can do

Using normal map

- back face culling
- silhouette enhancing (increase importance)
- extrusion, etc.

Using curvature map

- smooth gradation using gaussian filtering

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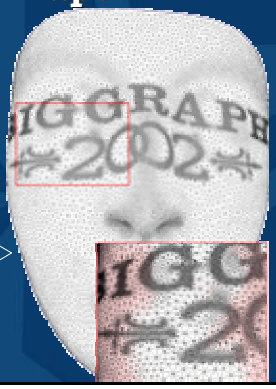
User-Defined Maps

paint either in the importance map or directly on the mesh



Conclusion

Interactive Geometry Remeshing

- **Area-balanced** atlas
- Easy, rapid, and **flexible design** using **2D maps**
- **Real-time resampling**
- Interactive, **output-sensitive remeshing**
- Correct handling of **features** and borders

Future Work

- **Improve precision**
  - large images needed for high accuracy
- **Compression**
  - rate/distortion approach
- **Approximation Theory**
  - optimal sampling?
  - with respect to what norm?